Long-term evolution and orbital poles of binary NEAs and small MBAs

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I present two recent results based on photometric observations of near-Earth and small main-belt binary asteroids.

An evolution of binary system depends heavily on the BYORP effect. If BYORP is contractive, the primary and secondary could end up in a tidal-BYORP equilibrium. Observations of mutual events between binary components in at least four apparitions are needed for BYORP to be revealed by detecting a quadratic drift in the mean anomaly of the satellite.

I will show the observational evidence of two single-synchronous binary asteroids with tidally locked satellite (175706 1996 FG3 and 385186 1994 AW1), i.e, with the quadratic drift equal to zero, and one with contracting orbit (88710 2001 SL9), with a positive value of the quadratic drift (the solution for the quadratic drift is ambiguous, with possible values of +2.9 and +5.1 deg/yr^2).

The observed characteristics of asteroid systems suggest their formation by rotational fission of parent rubble-pile asteroids after being spun up by the YORP effect. The orientations of satellite orbits of observed binary systems are non-random; the orbital poles concentrate near the obliquities of 0 and 180 degrees, i.e., near the YORP asymptotic states.

Recently, a significant excess of retrograde satellite orbits was detected among both near-Earth and small main-belt binaries, which is not yet explained characteristic. Of 25 small MB binaries with unambiguously determined satellite orbits, 7 are prograde and 18 are retrograde. Similar fraction is observed among NEA and Mars-crossing binaries: of 10 systems with unambiguous orbits, 3 are prograde and 7 are retrograde.